REMARKS

Claims 8-14 and 35-47 stand rejected on prior art grounds. Applicants respectfully traverse these rejections based on the discussion below. Additionally, he feature of previously presented dependent claim 10 is amended herein into independent claim 8 and dependent claim 10 is cancelled. Thus, claim 8-9, 11-14 and 35-47 are all the claims pending in this application.

I. The Prior Art Rejections

Claims 8-10, 35, 37-39, 42-43, and 46 stand rejected under 35 U.S.C. 102(b) as being anticipated by Hite et al. (U.S. Patent No. 4,863,878), hereinafter referred to as Hite. Claims 11-14, 36, and 40-41 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Hite, in view of Thompson, et al. (U.S. Patent No. 6,020,244) hereinafter referred to as Thompson and Noguchi, et al. (U.S. Publication No. 2004/0135210), hereinafter referred to as Noguchi. Claims 44-45 and 47 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Hite, in view of Noguchi. Applicants respectfully traverse these rejections based on the following discussion.

More particularly, the Applicants submit that Hite does not teach or suggest the following features of amended independent claim 8 or the similar features of amended independent claims 35 and 42: (1) "wherein the top surface of said silicon substrate has an oxygen content comprising an amount below that which would prevent epitaxial growth;" and (2) "wherein said amount of said oxygen content substantially limits dopants … from moving into said silicon substrate."

Specifically, Hite discloses methods of forming silicon on insulator (SOI) structures (i.e., a structure with a pure silicon layer on and insulator layer). The background section of Hite (see

col. 1, line 40-col. 2, line 2 and Figures 1A-1D) discusses a prior art method of forming a SOI structure. Specifically, referring to Figures 1A-1D, oxygen ions are implanted into a silicon substrate 1 with an energy sufficient to cause implantation below the top surface of the substrate. During this implant process, the oxygen ions react with the substrate to form a silicon dioxide layer 3 below a crystalline silicon layer 5 of the substrate. The structure is then subjected to a high temperature anneal in order to anneal the damage caused to the crystalline silicon layer 5 in the substrate and to provide a good base for forming an crystalline epitaxial layer 7 on the surface of the crystalline silicon layer 5.

Hite's invention is similar to this prior art process but eliminates the anneal process (see col. 2, line 40-col. 3 line 16). Specifically, Hite indicates that the prior art is susceptible to radiation effects and discloses that omitting the anneal step has some advantageous results. That is, referring to Figures 2A-2D, Hite's invention discloses that a silicon substrate 21 undergoes a high dose, high energy oxide ion implant (e.g., 150 keV-200keV and $1.1 \times 10^{18}/cm_2$ - $2.2 \times 10^{18}/cm^2$) such that a buried silicon dioxide layer 23 is formed below a silicon top surface 25. The temperatures during the implant are kept between 400 and 600 degrees so as to maintain the crystallinity of the silicon surface 25. The anneal step is omitted and an epitaxial layer 27 is grown by CVD on the single crystalline silicon surface 25.

Contrarily, the present invention does not teach or suggest the formation of a silicon-on-insulator (SOI) structure. Rather, in the present structure the substrate is oxidized, e.g., by using a low dose, low energy implant (e.g., 0.1keV -20keV and $1.1 \times 10^{15}/cm_2$ - $2.2 \times 10^{17}/cm^2$) such that only the top surface (e.g., the top 50%, the top 10%, the top 1%) of the substrate is oxidized and this top has a higher amount of oxygen content than any other portion of the substrate. That

is, there is no silicon layer above the oxygen layer. However, the amount of oxygen content is still below an amount that would prevent epitaxial growth. (see paragraphs [0022]-[0023]). The structure further comprises an eptiaxial silicon layer grown from the top surface of the substrate. This epitaxial silicon layer can include an epitaxial silicon halo layer directly on the top surface and an epitaxial silicon source/drain layer on the eptiaxial silicon halo layer (see paragraph [0031]). The amount of oxygen content in top surface of the substrate limits dopants within the epitaxial silicon layer from moving into the silicon substrate so that the junction depth is limited by the epitaxial silicon thickness (see paragraph [0027]).

The Office Action continues to provide that Hite teaches "a silicon substrate 1, wherein the top surface of said silicon substrate has an increased oxygen content … and wherein said oxygen content of said top surface of said silicon substrate is below an amount that would prevent epitaxial growth (see epitaxial layer 7 or 27) is able to grow thereon." The Applicant's respectfully disagree. As discussed above, in both the prior art discussed in the background section of Hite and in Hite's invention, oxygen is implanted below the substrate surface, such that the substrate comprises a crystalline silicon layer at the top surface (see item 5 of Figure 1A or item 25 of Figure 2A) with a buried oxide layer underneath this silicon layer (see item 3 of Figure 1A or item 23 of Figure 2A). Thus, the top surface of the Hite substrate 2, 21 is not disclosed as having any oxygen content, much less an amount of oxygen content that is specifically below an amount that would prevent epitaxial growth.

In response to this argument, the Examiner further provided that layer 3 of Figure 1A of Hite "constitutes an increased oxygen content at the top surface of the substrate since other regions of the substrate is not doped with oxygen." The Applicants respectfully disagree. Col. 1,

lines 40-51, of Hite refers to Figure 1A and discloses "Oxygen ions are implanted into the surface of substrate 1 with energy sufficient to cause implantation below crystalline region 5. These ions react with substrate 1 to form silicon dioxide layer 3 with crystalline silicon layer 5 on the surface." Thus, the structure in Figure 1A of Hite is a substrate 1 having various layers due to an oxygen implantation process. The top surface of this substrate 1 is part of a crystalline silicon layer 5 and below that crystalline silicon layer 5 is the implanted buried oxide layer 3. No where in Hite does it teach or disclose that the top surface of the substrate 1, 21 has an oxygen content.

In rejecting previously presented dependent claim 10 (amended herein into independent claim 8), the Office Action provides that "since Hite et al. teach the claimed structure, the increased oxygen content substantially would inherently limit dopants within the silicon layer and the silicon source/drain layer from moving into said substrate". In rejecting independent claims 35 and 42, the Office Action provides that Hite Figures 1A-1D and 2A-2D and the associated text disclose "a silicon layer 9 directly on said top surface of the silicon substrate 1 having oxygen content 3 the silicon layer comprising dopants (source/drain); wherein said dopants inherently are substantially limited to said silicon layer by the increased oxygen content 3 of said top surface of said silicon substrate." The Applicants respectfully disagree.

As discussed above and illustrated in Figures 1A and 2A, the substrate 1, 21 includes various layer due to an implantation process. At the top surface of the substrate 1, 21, there is a crystalline silicon layer 5, 25 (which does not have an oxygen content) and below that silicon layer 5, 25 is an implanted buried oxide layer 3, 23. Per col. 1, lines 47-51, the "structure of FIG.1A is the subjected to a high temperature anneal … to anneal the damage to crystalline

silicon layer 5 and provide a good base for forming a crystalline epitaxial layer on the surface of crystalline silicon layer 5." Thus, the epitaxial layer 7, 27 of Hite is grown on the non-oxygen containing silicon layer 5, 25 at the top surface of the substrate 1, 21.

It should be noted that while the subsequent figures (i.e., see Figures 1B-1D and 2B-2D) do not continue to show silicon layer 5, 25, it is clear from the description in the text that this silicon layer 5, 25 of the substrate 1, 21 remains intact and the epitaxy process is performed so that the epitaxial layer 7, 27 is grown therefrom. Therefore, the epitaxial layer 7, 27 of Hite is necessarily not grown on a top surface having an oxide content and, specifically, is not grown on the oxide layer 3 which (as discussed above) the Office Action indicates constitutes an increased oxygen content at the top surface of the substrate.

Additionally, after epitaxial layer 7, 27 is formed, it is patterned and etched to form a mesa structure 9, 29. Mesa 9, 29 is then doped to form source/drain regions (see col. 1, lines 50-65 and col. 3, lines 18-48). Again, although mesa structure 9, 29 is illustrated as being formed directly on buried oxide layer 3, 23, it is clear from the description in the text that this silicon layer 5, 25 of the substrate 1, 21 remains intact and is present between mesa 9 and buried oxide layer 3 (see col. 1, lines 49-52 and col. 3, lines 1-13). Since non-oxygen containing silicon layer 5, 25 of the substrate 1, 21 is necessarily present between mesa 9, 29 and buried oxide layer 3, 23, there is nothing to prevent the source/dopants in the mesa from diffusing or being implanted through the top surface of the substrate 1, 21 into silicon layer 5, 25. That is, while buried oxide layer 3, 23 would inherently prevent dopants from the epitaxial layer 7, 27 (i.e., from mesa 9, 29) from spreading further into the substrate 1, 21, this buried oxide layer 3, 23 would do nothing to limit such dopants to the epitaxial layer or to prevent such dopants from diffusing into that

portion of the substrate 1, 21 that is above the buried oxide layer 3, 23 and below the mesa 9, 29.

Therefore, amended independent claims 8, 35 and 42 are patentable over Hite. Further, dependent claims 9, 11-14, 36-41 and 43-47 are similarly patentable, not only by virtue of their dependency from a patentable independent claim, but also by virtue of the additional features of the invention they define. Moreover, the Applicants note that all claims are properly supported in the specification and accompanying drawings, and no new matter is being added. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejections.

II. Formal Matters and Conclusion

With respect to the rejections to the claims, the claims have been amended, above, to overcome these rejections. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejections to the claims.

In view of the foregoing, Applicants submit that claims 8-9, 11-14 and 35-47, all the claims presently pending in the application, are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary. Please charge any deficiencies and credit any overpayments to Attorney's Deposit Account Number 09-0458.

Respectfully submitted,

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